

**VEHICLE WHEEL BALANCE WEIGHTS**

Priority Claim

This application claims the benefit of provisional application serial no. 60/396,075, filed July 15, 2002, and provisional application serial no. 5 60/411,961, filed September 19, 2002, which are relied upon and incorporated herein by reference.

Background of the Invention

The present invention relates to wheel balance weights.

10 In order to reduce excessive vibration, vehicle wheels are often balanced by placing weights at selected locations. The weights include a mass portion which is attached to the wheel's rim using a spring clip or a suitable adhesive. Due to high mass 15 and low cost, such weights have been made of lead. Because of various factors, however, it is becoming desirable to manufacture such weights of materials other than lead.

Summary of the Invention

20 The present invention provides a variety of configurations for a vehicle wheel weight. Preferred embodiments utilize iron or low carbon steel for mass instead of lead as has generally been used in the past. Many embodiments are attached to the wheel 25 using a spring clip preferably made of spring steel. In such embodiments, a depression or groove may be formed in the center section of the mass with a width that matches the spring clip as required to achieve the desired fit during assembly. Depth of the groove

may match the spring clip thickness or be slightly greater. The depth match would continue around the mass surface as required to provide a nest for the clip.

5 In accordance with other embodiments of the present invention, the weight may comprise a mass portion configured as a strip of one or more interconnected weight segments having adhesive on a back surface thereof. For example, the adhesive may  
10 be provided by double-sided tape located on the back surface of the strip. Preferably, the release liner of the tape will extend a short distance beyond the longitudinal end of the strip so as to provide a pull tab at this location. The segments are defined and  
15 interconnected by grooves formed in the nonlead material.

#### Brief Description of the Drawings

A full and enabling disclosure of the present invention, including the best mode thereof, to one of  
20 ordinary skill in the art, is set forth more particularly in the remainder of the specification, including reference to the accompanying drawings, in which:

Figure 1A is a front elevational view of a  
25 vehicle wheel weight constructed in accordance with a first embodiment of the present invention;

Figure 1B is a cross sectional view taken along line 1B-1B of Figure 1A showing the wheel weight further mounted to the rim of a wheel;

30 Figure 1C is a bottom view of the wheel weight of Figure 1A;

Figure 2A is a cross sectional view of the mass portion of a vehicle wheel weight in accordance with the present invention made solely of a nonlead material such as iron or low carbon steel;

5        Figure 2B is a cross sectional view similar to Figure 2A but showing a mass portion made of an outer sheath of nonlead material with lead on the inside;

10        Figure 3A is a front elevational view of a vehicle wheel weight constructed in accordance with a second embodiment of the present invention before material for retaining the clip is swaged into place;

Figure 3B is a cross sectional view taken along line 3B-3B of Figure 3A;

15        Figure 3C is a bottom view of the wheel weight of Figure 3A;

Figure 3D is a view similar to Figure 3A but with the retaining material swaged into place;

Figure 3E is a cross sectional view taken along line 3E-3E of Figure 3D;

20        Figure 3F is an enlarged cross sectional taken along line 3F-3F of Figure 3D;

Figure 4A is a front elevational view of a vehicle wheel weight constructed in accordance with a third embodiment of the present invention;

25        Figure 4B is a cross sectional view taken along line 4B-4B of Figure 4A;

Figure 4C is an enlarged cross sectional taken along line 4C-4C of Figure 4A;

30        Figure 5A is a front elevational view of a vehicle wheel weight constructed in accordance with a fourth embodiment of the present invention;

Figure 5B is a cross sectional view taken along line 5B-5B of Figure 5A;

Figure 5C is an enlarged cross sectional taken along line 5C-5C of Figure 5A;

5        Figure 6A is a front elevational view of a vehicle wheel weight constructed in accordance with a fifth embodiment of the present invention;

Figure 6B is a cross sectional view taken along line 6B-6B of Figure 6A;

10       Figure 6C is an enlarged cross sectional taken along line 6C-6C of Figure 6A;

Figure 7A is a front elevational view of a vehicle wheel weight constructed in accordance with a sixth embodiment of the present invention;

15       Figure 7B is a cross sectional view taken along line 7B-7B of Figure 7A;

Figure 7C is an enlarged cross sectional taken along line 7C-7C of Figure 7A;

20       Figure 8A is a front elevational view of a vehicle wheel weight constructed in accordance with a seventh embodiment of the present invention;

Figure 8B is a cross sectional view taken along line 8B-8B of Figure 8A;

25       Figure 8C is a bottom view of the wheel weight of Figure 8A;

Figure 9 is a perspective view diagrammatically illustrating one technique for producing the mass portion of nonlead wheel weights in accordance with the present invention;

30       Figures 9A and 9B are cross-sectional views of the mass material at the locations indicated by lines 9A-9A and 9B-9B, respectively;

Figure 10 is a plan view diagrammatically illustrating the steps that take place at the forming station indicated by line 10-10 of Figure 9;

Figures 11A and 11B illustrate a eighth  
5 embodiment of a vehicle wheel weight constructed in accordance with the present invention;

Figure 12A is a side elevational view of a tape-on version of a vehicle wheel weight constructed in accordance with the present invention;

10 Figure 12B is a plan view of the wheel weight of Figure 12A;

Figure 12C is an enlarged view of the portion so indicated in Figure 12A;

15 Figure 12D is an enlarged end view of the wheel weight of Figure 12A;

Figure 13 is an enlarged fragmentary view of an alternative tape-weight constructed in accordance with the present invention;

20 Figure 14A is a side elevational view of a further tape-on weight constructed in accordance with the present invention;

Figure 14B is a plan view of the wheel weight of Figure 14A;

25 Figure 14C is an enlarged end view of the wheel weight of Figure 14A; and

Figure 14D shows a vehicle wheel in section, with the wheel weight of Figure 14A mounted thereto.

Repeat use of reference characters in the present specification and drawings is intended to  
30 represent same or analogous features or elements of the invention.

### Detailed Description of Preferred Embodiments

It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not  
5 intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions.

Figures 1A through 1C illustrate a vehicle wheel weight 10 constructed in accordance with a first  
10 embodiment of the present invention. As shown, wheel weight 10 includes a mass portion 12 to which a spring clip 14 is attached. As shown, clip 14 (which may be made from spring steel) is located in a groove 16 which has a depth preferably equal to or slightly  
15 greater than the thickness of clip 14. As can be seen in Figure 1B, clip 14 serves to attach weight 10 to the rim 18 of a vehicle wheel.

As shown, clip 14 is preferably configured as a C-shaped member such that it "wraps around" mass  
20 portion 12 on the side opposite to rim 18. Clip 14 is retained in this case by one or more spot welds (such as spot weld 20) at suitable locations. For example, the spot weld may be made at the point on the clip most distant from the wheel rim flange.  
25 This is to prevent tempering of the spring steel of clip 14 near the location where the wheel rim is to be engaged.

Mass portion 12 is preferably made from a nonlead material having suitable mass, such as iron,  
30 low carbon steel or an impregnated polymeric. (See U.S. Patent No. 6,364,422 to Sakaki et al., incorporated herein by reference.) In Figure 2A,

mass portion 12 is preferably made entirely of iron or low carbon steel. Often, a 1008 steel will be especially preferred. Figure 2B illustrates an alternative mass portion 12' in which an outer sheath 22 of nonlead metal is filled with lead 24. In this way the lead component is encased within a skin of steel or other suitable rugged material.

Figures 3A through 3F illustrate a wheel weight 30 constructed in accordance with another embodiment of the present invention. As shown, weight 30 includes a mass portion 32 and a spring clip 34. In this case, clip 34 is attached via raised portions 36 (Figures 3A-3C) of mass material located at the sides of the groove in which clip 34 is seated. Raised portions 36 are then swaged over top of clip 34 (as indicated at 38 in Figures 3D-3F) to cause an interference fit with the clip.

Figures 4A through 4C illustrate a wheel weight 40 constructed in accordance with a further embodiment of the present invention. Weight 40 includes a mass portion 42 defining a groove into which a spring clip 44 is seated. Unlike the embodiment of Figures 3A-3F, this embodiment does not utilize a raised area beside the groove. Instead, the sides of the groove are swaged into the clip at points with a staking technique (as indicated at 46) to give a "stitched look."

A further embodiment of a wheel weight 50 constructed in accordance with the present invention is illustrated in Figures 5A through 5C. Weight 50 includes a mass portion 52 defining a groove into which a spring clip 54 is seated. As indicated at

56, the sides of the groove are swaged into the clip as described above except that a "wedge" is used to cause the top of the groove to close.

Referring now to Figures 6A through 6C, a wheel weight 60 constructed in accordance with a further embodiment of the present invention is illustrated. Weight 60 includes a mass portion 62 defining a groove into which a spring clip 64 is seated. In this case, the spring clip 64 may be approximately L-shaped (rather than C-shaped as in previous embodiments). As indicated at 66, an interference fit is created by providing the clip with serrated edges which are pressed into a groove having a width slightly less than the clip width. In this embodiment, it may be optionally desirable to also perform some swaging of material to further secure the interference fit.

Figures 7A through 7C illustrate a wheel weight 70 constructed in accordance with a further embodiment of the present invention. Weight 70 includes a mass portion 72 defining a groove into which an L-shaped spring clip 74 is seated. To secure the two components, an indentation is defined in each side of the clip. In this case, for example, the indentation is formed as a 1/3 circle. As indicated at 76, the groove is swaged enough to force metal into the indentation as well as over the top of the clip.

Figures 8A through 8C illustrate a further embodiment in which a wheel weight 80 is constructed in accordance with the present invention. It can be seen that weight 80 is similar to weight 10, except



the mass portion 82 and spring clip 84 are joined with a suitable adhesive (as indicated at 86) instead of spot welding. Although a stripe of structural adhesive as shown in the drawing may often be  
5 sufficient, in many cases it will be desirable to apply the adhesive liberally over the mating surfaces.

Referring now to Figures 9 - 10, one method of producing the mass portion from iron or low carbon  
10 steel will be described. This method utilizes raw material that is either round in cross-section or preformed with a shape that is either the same as or is substantially similar to the cross-section of the mass portion to be formed (such as round for a wheel  
15 balance weight). One "piece" of raw material would contain enough material for numerous wheel weight masses. This may be either a long rod 90 or a coil 92 with enough material for hundreds or thousands of finished mass portions.

20 In this case, the mass forming machinery comprises three subsystems working together. These may be described as follows:

1. Material handling and supply 94 - Either an "uncoiler" or rod feeding equipment is provided to  
25 deliver the raw material (e.g., iron).

2. Forming rolls 96 and 98 (or other suitable rolling machine) are provided to form the long (wheel size) radius and pre-form the shape that will fit into the rim flange. The amount of pre-forming would  
30 be inversely proportional to the size of press being used.

3. A metal forming press 100 is used to finish the rim flange shape, form a groove for the wheel balance weight clip, stamp product information into the surface, and cut to the required length. The  
5 press working surfaces would be a die that may be progressive or not depending on press size and part details. A large press forming a large part may be able to form all surfaces and cut to length in one stroke. Alternatively, small parts may need to be  
10 made in a progressive fashion to get all forming surfaces to bear on a small area. A small press could form a large part by using a progressive die and distributing the work over more than one press cycle.

15 As an alternative to the details shown in Figure 10, it may be desirable in some cases to form the cut-off "Preform" prior to "Shape Finishing." In fact some of the die operations might be done before the die. The die could then be a stamping/trim die.

20 Finally, suitable corrosion protection materials may be applied after assembling the mass and clip. Other finishing may or may not be required depending on customer finishing requirements.

Figures 11A and 11B illustrate a further  
25 embodiment of a wheel weight 110 constructed in accordance with the present invention. Weight 110 includes a mass portion 112 defining a cavity 114 in which spring clip 116 is inserted. Specifically, mass portion 112 may be cold formed with cavity 114  
30 form fitted inside the body of the weight. This will eliminate the need for having the clip extend over either the front or back of the clip.

Figures 12A-12D illustrate an alternative embodiment in which the weights may be attached to the wheel rim using an adhesive coating (i.e., a tape-on weight). Preferably, the mass portions are

5 formed as a flexible string of nonlead mass material having a predetermined number of segments. A covering (i.e., a release liner) which protects the adhesive is removed when it is desired to attached

10 the mass portion(s) to the wheel. The illustrated embodiment has several significant features, including: (1) deep grooves formed into its surface to make the string conformable to different size wheels, and (2) a unique pull tab arrangement.

As can be seen, tape-on weight 120 includes a

15 mass portion formed as a strip 122 of suitable nonlead material. Strip 122 is divided into a plurality of segments 124 defined by respective grooves 126. Groove 126 is formed as deep as possible, while leaving a small uncut zone 128 at the

20 bottom. Zone 128 permits the string to be flexed so as to conform to the arc of the rim to which it is to be attached. Each of the segments 124 will preferably have a predetermined weight, such as 5 grams.

25 In this embodiment, the adhesive is provided in the form of a two-sided tape 140 attached to the bottom surface of string 122. Preferably, tape 140 will include a conformable carrier of foam or the like having adhesive on each side. A release liner

30 132 is located on the back side of tape 130 so as to cover the adhesive until use. As illustrated in Figure 12D, the release liner may actually be formed

as two pieces of tape 132A and 132B configured to provide pull tables for easy removal. In this case, liner portion 132a is folded back on itself as shown in Figure 12D.

5        Figure 13 illustrates an alternative embodiment of a tape weight 140 constructed in accordance with the present invention. Weight 140 includes a mass portion formed as a strip 142 of weight segments 143 defined by transverse grooves 145. Groove 145 is  
10    configured to leave a small uncut zone 146 near the bottom of strip 142. A double-sided tape 147 is located on the back side of strip 142. A release liner 148 is provided behind double-sided tape 147 so as to protect the adhesive.

15        A small tab 149 connected to (or integral with) release liner 148 extends from the longitudinal end of strip 142 so as to facilitate removal of release liner 148. In this case, tab 149 is formed as a  
20    separate piece of tape which overlaps the end of release liner 148 (as indicated at 150) and overlaps itself (as indicated at 151). Silicone tapes are believed to be particularly suitable for tab 149.

      Generally, weight 140 will be sold in a variety of different numbers of segments depending upon the  
25    total weight to be achieved. For example, a typical construction may have two to six segments of 5 grams each. As a result, total weight will fall in a range of 10-60 grams. Larger weight sizes may also be desirable in certain applications.

30        Preferably, zone 146 will be as thin as possible in order to provide for greatest flexibility. For example, embodiments are contemplated in which the

thickness of zone 146 is about three thousandths of an inch. Generally, the thickness would not exceed twenty thousandths in presently preferred embodiments.

5        It is also desirable that the width of groove 145 be substantial so as to prevent surface treatment bridging which adds stiffness to the overall weight. Specifically, the weight may be subjected to a variety of surface treatments in order to reduce  
10 corrosion and the like. For example, zinc plating (or zinc phosphate wash) followed by epoxy powder and painting may be employed. Making groove 145 of sufficient width will prevent these surface treatments from adding significant stiffness to the  
15 overall weight. In presently preferred embodiments, the width of groove 145 will typically be at least fifty thousandths of an inch at its widest point (the mouth). Often, widths of around 130 thousandths will be preferred.

20        Referring now to Figures 14A-14D, a further embodiment of a tape-on weight constructed in accordance with the invention is illustrated. As can be seen, tape-on weight 160 is made of non-lead material, such as iron or low carbon steel. The mass  
25 portion 162 of weight 160 is preformed in an arc having a radius approximating that of the surface to which it is to be mounted. Dimensions (such as length) of the wheel weight are determined based on the desired mass. In addition, the weight must not  
30 be made of a size (e.g., thickness and width) such that it would interfere with the operation of other vehicle parts.

An adhesive (here in the form of a double-sided tape 164) is located on the outer diameter of mass portion 162. Although mass portion 162 will generally be rigid, the presence of the adhesive will  
5 provide a degree of elasticity (conformability) to accommodate varying wheel diameters. The adhesive is protected prior to use using a release liner 166, which is in this example similar to release liner 132 (Figure 12D).

10 While preferred embodiments of the invention have been shown and described, modifications and variations may be made thereto by those of ordinary skill in the art without departing from the spirit and scope of the present invention. In addition, it  
15 should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to be  
20 limitative of the invention as further described in the appended claims.